

NON-PUBLIC?: N  
ACCESSION #: 9011010038  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Braidwood 1 PAGE: 1 OF 09

DOCKET NUMBER: 05000456

TITLE: Spurious Train B Solid State Protection System Actuations due to  
Component Failure, Personnel Error, and Component Design  
Interface Deficiency.

EVENT DATE: 09/29/90 LER #: 90-018-00 REPORT DATE: 10/29/90

OTHER FACILITIES INVOLVED: None DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 092

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:

50.73(a)(2)(i) & 50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Jerald Wagner, LER Coordinator TELEPHONE: (815) 458-2801  
Ext. 2497

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: JE COMPONENT: BUF\* MANUFACTURER: W120

X VF MO\*\* R165

X EA BKR\* W120

X SB PCO\* W120

REPORTABLE NPRDS: yes

yes

yes

yes

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At 0345 on September 29, 1990 the Train B Solid State Protection System (SSPS) initiated a Containment Ventilation Isolation Signal. No components repositioned as all were in their required state. At 1735 a spurious Train B Safety Injection Signal (SI) occurred causing a Reactor Trip and Containment Isolation to occur as well as starting Train B ECCS components. The B Train of SSPS was declared inoperable and a plant cooldown was initiated. At 0013 on September 30, 1990 a Reactor Operator

was performing an SSPS test procedure when the Train B SSPS Memories Test switch was inadvertently rotated from Off to position 23. This enabled the Pressurizer and Steamline Low pressure SI and Steamline Isolation circuits which had been blocked. With both pressures below their respective setpoints, a Train B SI and a Steamline Isolation occurred. Due to the Steamline isolation, the RCS temperature increased about 12 degrees from 340 to 352 degrees F over the next 14 minutes until cooling was re-established. 350 degrees F is the lower limit of Mode 3 operation. At 1020 on October 3, 1990 a spurious Train B Feedwater Isolation occurred with the Unit in Cold Shutdown. The causes of the event were component failure, personnel error, and component design interface. Train B SSPS was repaired, training will be provided, and the Memories Test Switch was re-oriented. Previous Corrective actions are not applicable to this event.

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END OF ABSTRACT

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#### A. PLANT CONDITIONS PRIOR TO EVENT:

##### Occurrence #1

Unit: Braidwood 1; Event Date: September 29, 1990; Event Time: 0345

Mode: 1; - Power Operation Rx Power: 92%;

RCS AB! Temperature/Pressure: NOT/NOP

##### Occurrence #2:

Unit: Braidwood 1; Event Date: September 29, 1990; Event Time: 1735;

Mode: 1 - Power Operation Rx Power: 99%;

RCS Temperature / Pressure: NOT/NOP

##### Occurrence #3:

Unit: Braidwood 1; Event Date: September 30, 1990; Event Time: 0013;

Mode: 4 - Power Operation Rx Power: 0%;

RCS Temperature / Pressure: 340 degrees F/1100 psig

Occurrence #4:

Unit: Braidwood 1; Event Date: October 3, 1990; Event Time: 1020;

Mode: 5 - Cold Shutdown; Rx Power: 0%;

RCS Temperature / Pressure: 180 degrees F/360 psig;

#### B. DESCRIPTION OF EVENT:

There were no systems or components inoperable at the beginning of the event which contributed to the severity of the event.

At 0345 on September 29, 1990 Unit 1 Train B Solid State Protection System (SSPS) JE! initiated a Containment Ventilation Isolation Actuation VA! signal for Train B. No components repositioned as all were in their ESF required state.

At 0404, after verifying that a High Radiation Condition did not exist, the Nuclear Station Operator (NSO) (Licensed Reactor Operator) reset the signal.

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At 0511 the appropriate NRC notification was made via the ENS phone system pursuant to 10CFR50.72(b)(2)(i).

At 1735 the following spurious actuation signals were received as indicated by the Sequence of Events Recorder (SER).

1. Containment Ventilation Isolation Train B.
2. Containment Phase A Isolation Train B.
3. Train B Safety Injection (SI) BQ, BR! components actuating.
4. Turbine Trip
5. Reactor Trip

This is the order the signals were received on the Sequence of Events Recorder. A Safety Injection Signal would initiate the other 4 actuations. The red first out annunciators received were "Turbine Trip above P-8" on the Reactor Control Annunciator Board, and "Reactor Trip/Turbine Trip" On the Turbine Control Annunciator Board.

The NSOs under the direction of the Station Control Room Engineer (SCRE) and the Shift Supervisor (SS) (Licensed Senior Reactor Operators) entered the appropriate Emergency procedures. After verifying that a valid condition for a Safety Injection had not occurred, automatic actions were verified for components that would actuate from the B Train of SSPS. The following components did not revert to their expected ESF configuration.

1. The running Feedwater (FW) SJ! Pumps 1B and 1C did not trip. These pumps were manually tripped by the NSO.
2. The motor operated discharge valves of all three FW pumps, 1FW002A, B, and C did not automatically close. The NSO manually closed the valves.
3. The D Steam Generator FW regulating valve, 1FW0540, initially showed dual indication. After several minutes it went full closed without operator action.
4. The Non Accessible Filter Plenum Charcoal Booster Fans VF! for the 0B and 0C Plenums, Fans 0D and 0E respectively, did not auto start. At the direction of the SS and SCRE, the fans were not manually started.

All other components functioned as expected. Stable plant conditions were immediately established. The minimum RCS pressure during the event was 2170, maximum Pressurizer Level was 75%, and RCS temperature essentially followed the program band as it returned to 557 degrees F following the trip. The increase in Pressurizer level corresponds to an increase in inventory of approximately 2000 gallons.

At 1743 the NSO reset the SI signal in accordance with the Emergency Procedures. ECCS components that had actuated were secured and placed in standby. Automatic SI capability for Train B SSPS was not reestablished at this time as a cognizant decision by the SS and SCRE.

At 1819 the NSOs placed all Train B ECCS component control switches in the pullout position. This was done at the direction of the SS to preclude an auto start while re-establishing Auto SI capability for Train B SSPS. The Reactor Trip breakers AA! were cycled which is the method for re-enabling automatic SI. No train B SSPS actuations occurred. The control switches were immediately returned to the after trip position which provides for automatic initiation. The A train of SSPS had been operable and available throughout the

event.

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At 1942 after completion of a preliminary review of the event, the B Train of SSPS was declared inoperable. The appropriate Technical Specification Action Statements were entered and complied with. A plant cool down was initiated to place the Unit in Mode 5, Cold Shutdown, to effect repairs to the B Train of SSPS in accordance with the Technical Specification Action Statement.

At 1943 the appropriate NRC notification was made via the ENS phone system pursuant to 10CFR50.72(b)(1)(i) and 10CFR50.72(b)(2)(ii).

At 2320 Unit 1 entered Mode 4, Hot Shutdown.

At 0013 on September 30, 1990 an NSO was performing the initial condition verifications for Braidwood Unit 1 Operating Surveillance (1BwOS) 3.1.1-21, "Unit One SSPS, Reactor Trip Breaker, and Reactor Trip Bypass Breaker Bi-Monthly (Staggered) Surveillance (Train B)". Portions of this procedure were going to be performed in an attempt to trouble-shoot the B Train of SSPS. In accordance with step F.1.4.f, the "Memories Test Switch" was to be verified in the "OFF" position. The NSO observed that the switch was part way between position off and position 1. The NSO lightly turned the switch toward the off position, believing that it actually was in that position but appeared part way out of position due to "free play" in the switch. This action caused the switch to rotate to position 23. Placing the switch in position 23 resulted in the Pressurizer Pressure Low Pressure SI and the Main Steamline Low Pressure SI and Steamline Isolation, which had been blocked, to be re-enabled for Train B. A Train B SI and Steamline Isolation occurred.

The appropriate immediate actions were verified in accordance with the emergency procedures. Once again, the Auxiliary Building Non-Accessible Filter Plenum Charcoal Booster Fans did not auto start. The FW components that did not actuate during the previous Train B SI were already in their ESF positions. All other components functioned as designed.

At 0015 the SI signal was reset and the Train B ECCS components were secured. The 1B Auxiliary Feedwater (AF) BA! pump was also secured. The 1A AF pump, which had been in operation prior to the SI actuation, remained in operation. Due to the Steamline

Isolation, temperature control via the steam dumps was momentarily halted. This caused RCS temperature to begin increasing. The RCS temperature was being maintained at 340 degrees F prior to the Steamline Isolation.

At 0021 the 1A AF pump tripped on low suction pressure. The NSO started the 1B AF pump.

At 0023 the NSO observed that the RCS Temperature had increased to 346 degrees F. The NSO opened the Steam Generator Power Operated Relief Valves (PORV) on the A, B, and D Steamlines to approximately 10% open in an attempt to maintain temperature.

At 0025 the NSO, who observed that RCS temperature had increased to 348 degrees F, opened the A, B, and D PORVs to 100% open.

At 0026 the Shift Engineer (SE) (Licensed Senior Reactor Operator) directed the NSO to reset the Main Steamline Isolation and re-initiate temperature control via the steam dumps. The NSO reset the Main Steamline Isolation Signal and closed the steam dumps which had been open in manual. During the next several minutes the NSO opened the Main Steamline Isolation Valve (MSIV) By-pass valves one at a time. This resulted in pressurizing the Steamlines from an initial pressure of approximately 1 psia, to 90 psig within a one minute time period. Additionally, the NSO reopened the steam dumps when pressures appeared equal. Due to the relatively low Steamline pressure of 90 psig, temperature response in the RCS was sluggish.

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At 0028 the RCS Temperature increased to 350 degrees F which is the lower limit for Mode 3, Hot Standby, conditions.

At 0030 RCS reached 352 degrees F and then started to decrease in response to the cooling effects of the steam flow via the steam dumps and the PORVs.

At 0033 the RCS decreased below 350 degrees F. When temperature returned to 340 degrees F steam flow was reduced and the RCS was maintained at that temperature.

As a result of the SI, Pressurizer level increased from an initial value of 31% to 63%. This would correspond to a volume increase of approximately 3860 gallons. Additionally, RCS pressure which was at

1100 psig at the start of the event increased to 1300 psig. Stable plant conditions were immediately established.

At 0045 the NSO started the 1A AF pump.

At 0046 the 1A AF pump again tripped during manipulations with the flow control valves. The 1B AF pump remained in operation throughout the evolution.

At 0050 while attempting to close the D PORV, the controller 1PK-MS044A appeared to de-energize. The PORV indicated 2 - 3% open at the time. The NSO shifted the control switch from the auto to the close position and the valve went full closed.

At 0236 the appropriate NRC notification was made via the ENS phone system pursuant to 10CFR50.72(b)(2)(ii).

At 2210 Unit 1 entered Mode 5.

At 0001 on October 1, 1990 RCS temperature reached 180 degrees F and the cool down was terminated.

At 1020 on October 3, 1990 the NSO observed that the FW tempering line isolation valves on the A and B Steam Generators were isolated and the FW isolation actuated light was illuminated for Train B. The NSO reset the FW isolation and established FW flow to the A and B Steam Generators.

The appropriate NRC notification via the ENS phone system was made at 1153 pursuant to 10CFR50.72(b)(2)(ii).

On October 11, 1990 during a plant inspection tour it was identified that a pipe hanger on the 1B Main Steamline was damaged. The hanger embed plate had pulled away from the concrete that it was connected to. The SE was immediately notified. During the next several days a detailed inspection of the Main Steamline Pipe support system was conducted for the steamlines of Unit 1 and Unit 2. The inspection identified that 13 additional pipe supports on the 1 B Main Steamline had experienced some degree of movement. There was no evidence of any movement on any other steamline on Unit 1. Additionally, there was no evidence of any pipe movement on any of the Unit 2 Main Steamline pipe supports including the 2B Main Steamline which has similar characteristics in regards to supports and pipe routing as its Unit 1 counterpart.

This event is being reported pursuant to:

10CFR50.73(a)(2)(iv) - any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature, including the Reactor Protection System.

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10CFR50.73(a)(2)(i)(A) - The completion of any nuclear plant shutdown required by the plant's Technical Specifications.

10CFR50.73(a)(2)(i)(B) - Any operation or condition prohibited by the plants Technical Specifications.

#### C. CAUSE Of EVENT:

The root cause of the Spurious Train B SSPS actuations has been attributed to an internal problem with SSPS processing circuitry. The actuations did not produce first out annunciators consistent with process input or input logic bay function problems. This would tend to indicate that the problem was related to the output function portion of Train B SSPS. Additionally there were no indications of bistable status lights illuminating or SER printouts that would be an indication of process input malfunctions.

The cause of the failure of the 1B and C FW pumps to trip and the 1FW002A, B, and C valves to close during the first SI initiation has been attributed to the extremely short duration of the SI signal. The actuation of these FW components is accomplished by energizing a non latching relay in the output portion of SSPS which in turn energizes a non-latching auxiliary relay, external to Train B SSPS, which initiates the actuation. Due to the nature of the spurious signal, it is believed that duration of the signal was too short to initiate the function.

The cause of the failure of Auxiliary Building Non Accessible Filter Plenum Charcoal Booster Fans 0D and 0E to auto start has been identified as component failure exclusive to the B Train SSPS. Further investigation revealed that the 0D fan had a defective breaker and the 0E fan had a defective motor.

The cause of the failure of the 1FW0540 valve to indicate full closed has been identified as a minor mis-adjustment of a limit switch.



The root cause of the inadvertent SI that was initiated by operation of the Memories Test switch in the B Train SSPS has been attributed to Personnel Error. A contributing cause to the event was equipment interface design for the control indication of the Memories Test Switch.

The root cause of the 1A AF pump trips has been attributed to oscillations of the AF flow control valves during control at lower flow rates. Tests conducted on October 2, 1990 with the low suction pressure trip bypassed identified three cases of suction pressure dips below the trip setpoint occurring during flow control valve manipulations at low flow conditions.

The failure of the D Steamline PORV has been attributed to a failure of the controller.

The root cause of the damage to the 1B Main Steamline Pipe supports is believed to be the result of abnormal steam/water hammer forces being exerted on the steamline piping during the pressurization of the Main Steamline System that occurred at 0029 on September 30, 1990. The steamline piping downstream of the MSIV's, was pressurized from an initial pressure of approximately 1 psia to 90 psig within the time span of 1 minute. This occurred 16 minutes following the inadvertent Main steamline Isolation. This evolution was performed due to the perceived need to halt the gradual RCS temperature increase prior to reaching the Mode 3 temperature limit of 350 degrees F.

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#### D. SAFETY ANALYSIS:

This event had no effect on the safety of the plant or the public. The SSPS actuations that were generated were neither desired nor required and were inappropriate for the existing plant conditions. The redundant A Train of SSPS was operable and available to initiate the necessary ESF actuations had a valid need occurred. Additionally, it has been concluded that the problems with the Train B SSPS processing circuitry would not have precluded its initiation of the appropriate ESF actuations had a valid need occurred.

Under the worst case condition of a valid situation occurring requiring any or all of the ESF actuation functions of SSPS there

would still be no effect as this is enveloped in section 7 of the Updated Final Safety Analysis Report. The redundancy and physical train separation of the SSPS provide for initiation and actuation of adequate components to perform all required safety functions from a single Train of SSPS combined with it's associated train of operable output components. The A Train of SSPS including all associated A Train components were operable and available throughout the event.

#### E. CORRECTIVE ACTIONS:

Immediate Corrective actions were to verify automatic actuations and place the plant in a stable condition. The Unit was placed in Cold Shutdown to effect repairs.

A Westinghouse SSPS expert was contacted and arrived on site October 1, 1990 to assist plant personnel with the trouble shooting effort. Trouble shooting efforts for Train B SSPS did not positively identify a defective component, but by systematically evaluating the nature of the failures it was concluded that the most likely cause would be the intermittent failure of Safeguards Output Card A516. The card was replaced. The removed card was placed on a test rack and is currently being monitored. As an additional measure, the following components were also replaced:

Safeguards Output Card A517  
Universal Logic Cards A213, A313, A308, A311, A416, A210  
48/15 volt power supply #1

A visual inspection of the termi point connections of the replaced cards was performed. A stray 3/8 inch long piece of bare #22 wire with solder on one end was found in the area of cards A213 and A313. Examination using a microscope identified indications of arcing. It is theorized that this wire may have caused a momentary short across several pins causing some or all of the spurious actuations. No other problems were identified during the inspection.

The Memories Test switch was rotated so that the indicator points directly at OFF when the switch is in the off position.

As an additional measure the Train B SSPS is being monitored by use of scopes and chart recorders in an attempt to ensure that all components are performing in a reliable manner. Both the SSPS monitoring and the testing of the cards that were removed are still in progress. These actions will be tracked to completion by action item 456-200-90-03901.

A modification to the AF pump flow control valves was planned for the next refueling outage. As a result of this event, the modification was completed during this unit shutdown. This modification changed the valve trim of the AF flow control valves to provide for better control throughout all ranges of AF flow. This modification was previously installed on the associated AF valves of Braidwood Unit 2 and on both Byron Units. Preliminary results have indicated that this modification corrects the problems of oscillations at low flow conditions.

The breaker for Auxiliary Building Non Accessible Filter Plenum Charcoal Booster Fan 0D has been replaced. The motor for the 0E fan is being replaced. These failures will be evaluated for adverse trend concerns in accordance with the normal root cause trending process.

The control card for the 1D Steamline PORV has been replaced. The valve has performed satisfactorily since replacement.

The pipe supports for all four steamlines were inspected. In addition to the damaged embed plate for pipe support 1MS01043R, there were 13 additional pipe supports requiring rework as a result of the transient. All pipe supports identified were on the B Steamline. There were no abnormalities identified on any of the other steamlines that were a result of the transient.

Surface and visual exams were performed on the B Steamline piping. No signs of piping degradation were identified. Additionally, the Braidwood 1 Architect and Engineer, Sargent & Lundy, performed a pipe stress analysis using data collected from a detailed inspection of the failed support. Based on the results of this analysis it was concluded that the stresses the B steamline experienced were within allowable limits. This analysis was further supported by the results of the surface and visual inspections.

All pipe support rework was completed prior to the return to power operation which occurred on October 22, 1990.

Braidwood Operating Procedure (BwOP) MS-9, "Equalization of Pressure Around the Main Steam Isolation Valves", has been revised to notify the Technical Staff to perform a walk down of the of the steam tunnel portion of the MS system following the completion of BwOP

MS-9 or following a Main Steamline Isolation Event. This action is documented in action item 456-200-90-03902.

This event will be covered as part of Operator training, emphasizing the need to follow the provisions of BwOP MS-9. As an interim measure, all MSIV's and MSIV bypass valves will be caution carded to require strict adherence to the provisions BwOP MS-9 prior to operating the valves. These cards will remain in effect until training is completed for all current on shift licensed operating personnel. This action will be tracked to completion by action item 456-200-90-03903.

Pipe supports on the 1 B Main Steamline have been adjusted to remove the small incline on both the north - south, and east - west portion of the steamline.

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#### F. PREVIOUS OCCURRENCES:

There have been previous occurrences of Spurious ESF actuations. The corrective actions were implemented addressing both root and contributing causes. Previous corrective actions are not applicable to this event.

#### G. COMPONENT FAILURE DATA:

Manufacturer Nomenclature Model Number MFG Part Number

Westinghouse Safeguards Output 6056D32G01  
Card

Reliance Fan Motor 34F882594A7WD

Westinghouse 480V Breaker DS206

Westinghouse Controller/MA 8802D01G02  
1PK-MS044A

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Commonwealth Edison

Braidwood Nuclear Power Station  
Route #1, Box 84  
Braceville, Illinois 60407  
Telephone 815/458-2801

October 29, 1990  
BW/90-1068

U. S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, D.C. 20555

Dear Sir:

The enclosed Licensee Event Report from Braidwood Generating Station is being transmitted to you in accordance with the requirements of 10CFR50.73(a)(2)(iv), 10CFR50.73(a)(2)(i)(A), and 10CFR50.73(a)(2)(i)(B) which require a 30-day written report.

This report is number 90-018-00; Docket No. 50-456.

Very truly yours,

K. L. Kofron  
Station Manager  
Braidwood Nuclear Station

KLK/JDW/sjs  
(7126z)

Enclosure: Licensee Event Report No. 90-018-00

cc: NRC Region III Administrator  
NRC Resident Inspector  
INPO Record Center  
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